

Appl. No. 10/678,908
Examiner: EVERHART, CARIDAD, Art Unit 2891
In response to the Office Action dated April 28, 2005

Date: July 28, 2005
Attorney Docket No. 10112971

REMARKS

Applicant thanks the Examiner for acknowledging Applicant's claim to foreign priority and receipt of the certified copy of the priority document. Responsive to the Office Action mailed on April 28, 2005 in the above-referenced application, Applicant respectfully requests amendment of the above-identified application in the manner identified above and that the patent be granted in view of the arguments presented. No new matter has been added by this amendment.

Present Status of Application

Claims 1 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by Niitsu (US 5,137,839, hereinafter "Niitsu"). Claims 1, 2, 4, 7, 8, 9, 11, 14 and 16-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Tran et al (US 5,534,445, hereinafter "Tran"). Claims 6, 8, 12, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Niitsu. Claims 3 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tran in view of Yamazaki et al (US 5,840,600, hereinafter "Yamazaki").

In this paper, new claim 20 is added. Support for new claim 20 can be found, for example, on pages 11-12 and FIGS. 3d-3e of the present application. Thus, on entry of this amendment, claims 1-20 are pending in the application.

Reconsideration of this application is respectfully requested in light of the amendments and the remarks contained below.

Rejections Under 35 U.S.C. 102(b)

Claims 1 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by Niitsu. Claims 1, 2, 4, 7, 8, 9, 11, 14 and 16-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Tran. Applicant respectfully traverses the rejections for at least the reasons as follow.

Claim 1 recites a process for passivating polysilicon, comprising the steps of forming a polysilicon layer, and annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer.

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Claim 8 recites a process for fabricating a polysilicon thin film transistor, comprising the steps of forming a polysilicon layer on a substrate, and annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer.

Niitsu does not teach or suggest a process for passivating polysilicon comprising a step of annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer, as recited in claim 1.

Claim 1 recites a method of passivating polysilicon comprising a step of annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof. ***Thus, in the method recited in claim 1, an annealing step and an atom introduction process are performed in a single step.***

In the rejection of claim 1 over Niitsu, the Examiner asserts that:

Niitsu discloses the steps of forming a polysilicon layer ... and carrying out a thermal treatment ... which satisfies the limitation of an anneal step. There is introduced to the polysilicon fluorine, which can be introduced in the vapor phase ... which satisfies the limitation of the exposure to a fluorine-containing gas. It is disclosed that the polysilicon is thereby passivated ... because the combination of the fluorine atoms which are introduced with the dangling bonds of the polysilicon is a passivation.

See page 2 of the office action.

To anticipate a claim, a reference must teach every element of the claim. In this regard, the Federal Circuit has held:

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros.*

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v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

"The **identical invention** must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). [emphasis added]

With reference to Figs. 7 and 8, Niitsu teaches the following:

After the insulator film 13 is removed, as shown in FIG. 7, an atom 15 combined with a dangling bond of silicon, for example, **one or some of fluorine (F), fluoride, hydrogen (H) and carbon (C) is ion-implanted into the N-type polysilicon layer 11.**

As illustrated in FIG. 8, the polysilicon layer is patterned to form an emitter leading electrode. The resultant structure is covered with an interlayer insulation film 16 **and then undergoes a thermal treatment.**

See column 3, lines 19-27 of Niitsu.

The feature of the present invention resides in that **an atom is introduced into a polysilicon layer for forming an emitter leading electrode, then the atom is combined with a silicon atom having a dangling bond existing on the crystal grain interface of polysilicon by thermal treatment**, and the dangling bond of the silicon atom can thus be passivated."

See column 3, lines 61-67 of Niitsu.

Thus, the process for passivating polysilicon recited in Niitsu is a two-step process. First, fluorine (F), fluoride, hydrogen (H) and carbon (C) atoms are introduced into the polysilicon by ion-implantation. Then, after intervening processes, a thermal treatment process is performed to combine the atoms with silicon having dangling bonds existing on the crystal interface of the polysilicon to passivate the dangling bond of the silicon atom.

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Accordingly, Applicant submits that the method in Niitsu, in which an atom introduction process is performed before the thermal treatment process, does not anticipate a single step of ***annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer***, as recited in claim 1.

Tran does not teach or suggest a process for passivating polysilicon comprising a step of ***annealing*** using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof ***to passivate*** the polysilicon layer, as recited in claims 1 and 8.

In connection with the rejections of claims 1 and 8, the examiner asserts:

There is an anneal step in nitrogen-containing atmosphere which includes the activation of the source and drain, as it is disclosed by Tran.

See page 3 of the office action.

However, Tran in fact teaches:

The method of the present invention provides for ***hydrogen passivation*** of polysilicon grain boundaries in a reproducible manner that is much easier to control and much more production oriented than the method of the prior art.

By using both plasma hydrogenation and plasma deposition of a layer of an atom hydrogen containing substance, more consistent hydrogen passivation of the polysilicon is achieved.

See column 3, lines 44-53 of Tran.

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The now formed TFT is annealed at approximately 400°C in a forming gas of hydrogen and nitrogen at a ratio of 15:85. ***The annealing step is common practice in the art to improve the aluminum contact of the drain, source, and gate electrode.***

Hydrogen plasma hydrogenation is then performed at a temperature in the approximate range of 150°C to 400°C, preferably at a temperature of approximately 300°C, for a time in the range of 30 minutes to 4 hours. A radio frequency power density in the range of 0.5 W/cm² to 20 W/cm² is used. The reactant gas may be hydrogen or a mixture of hydrogen with nitrogen or with inert gases such as argon and helium. Alternatively, the plasma hydrogenation may be carried out in an electron cyclotron resonance chemical vapor deposition system (ECRCVD).

See column 4, lines 38-53 of Tran.

Thus, the process for passivating polysilicon recited in Tran involves hydrogenating the polysilicon thin film transistor and depositing an atomic hydrogen-containing layer. The preceding annealing step in a forming gas of hydrogen and nitrogen in Tran is used to improve the aluminum contact of the drain, source, and gate electrode.

Accordingly, Applicant submits that the process for passivating polysilicon in Tran, including the deposition of an atomic hydrogen containing layer on the polysilicon layer and preceding annealing step, does not anticipate a single step of ***annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer*** in which no atomic hydrogen containing layer is deposited, as recited in claims 1 and 8.

For at least the reasons described above, it is Applicant's belief that neither Niitsu nor Tran teach or suggest all the limitations of claim 1 and 8. Applicant therefore respectfully requests that the rejection of claims 1 and 8 be withdrawn and the claim passed to issue. Insofar as claims 2-7 and 9-19 respectively depend from claims 1 and 8, either directly or indirectly, and therefore incorporate all of the limitations of claims 1 and 8, it is Applicant's belief that these claims are also in condition for allowance.

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Rejections Under 35 U.S.C. 103(a)

Claims 6, 8, 12, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Niitsu.
Claims 3 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tran in view of Yamazaki et al.

With respect to claim 8, the Examiner asserts that it would be obvious to one of ordinary skill in the art at the time of the invention to have used fluorine as the fluorine gas source and to use the process in the formation of a thin film.

MPEP 2142 reads in part:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

In connection with the third criteria, MPEP 2143.03 goes on the state:

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970).

As described in connection with claim 1, the process for passivating polysilicon recited in Niitsu is a two-step process. Namely, fluorine (F), fluoride, hydrogen (H) and carbon (C) atoms are first introduced into the polysilicon by ion-implantation. Then, after intervening processes, a

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thermal treatment process is performed to combine the atoms with silicon having dangling bonds existing on the crystal interface of the polysilicon to passivate the dangling bond of the silicon atom.

Accordingly, Applicant submits that even when modified in the manner suggested by the Examiner, the method in Niitsu does not teach or suggest a single step of ***annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer***, as recited in claim 8.

For at least the reasons described above, it is Applicant's belief that even when modified in the manner suggested by the Examiner, Niitsu does not teach or suggest all the limitations of claim 8. For at least this reason, the office action fails to establish a *prima facie* case of obviousness in connection with claim 8. Withdrawal of the rejection is respectfully requested.

Furthermore, as noted above, it is Applicant's belief that claims 3, 6 10, 12 and 13 are allowable by virtue of their dependency from either claim 1 or claim 8. For this reason, the Examiner's arguments in connection with these claims are considered moot and will not be addressed here.

New Claim 20

New claim 20 recites a process for fabricating a polysilicon thin film transistor comprising the steps of forming a polysilicon layer on a substrate, forming a gate dielectric layer on the polysilicon layer, forming a gate on the gate dielectric layer, doping the polysilicon layer to form source/drain regions by using the gate as a mask, forming source/drain electrodes for the source/drain regions respectfully, and ***annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer, wherein passivation is performed before the source/drain electrodes are formed.***

For the reasons discussed above, it is Applicant's belief that none of the art cited in the office action teaches or suggests a step of annealing using a fluorine-containing gas, a chlorine-containing gas, an oxygen-containing gas, a nitrogen-containing gas, or mixtures thereof to passivate the polysilicon layer, as recited in claim 20.

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In addition, it is Applicant's belief that none of the art cited in the office action teaches or suggests that the step of annealing to passivate the polysilicon layer is performed before the source/drain electrodes are formed, as recited in claim 20. For example, in Tran the annealing step is performed after the source contact and drain contact are formed. See column 4, lines 33-40 of Tran.

For at least these reasons, it is Applicant's belief that claim 20 is allowable over the cited references.

Conclusion

The Applicant believes that the application is now in condition for allowance and respectfully requests so.

Respectfully submitted,



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